CUDA HW3 | Exponential Integral

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Task 1 - Cuda Implementation

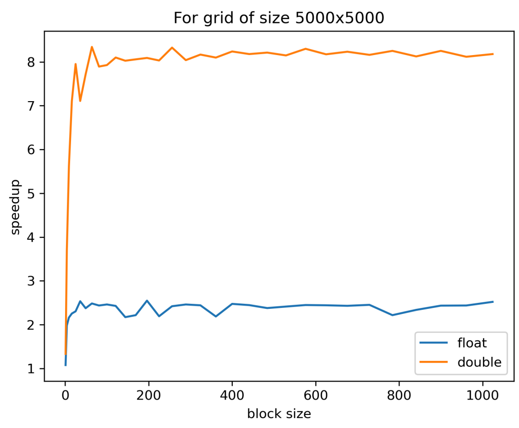
For this cuda implementation I chose to stick with using global memory and not using texture or suface memory as I did that in the last assignment. I used asyncronosy memory transfers in "main.cu" to take device data and move to the host. I made a very bad dynamic parallelism function which is used which spawns a grid from one thread. I tried using constant memort but could only think of using it in the decleration of the euler constant in "funcs.h". I made few more flags to be used by the "main" executable which make writing the scripts easier for me. They are added to the "printUsage()" function but ill paste the relevant lines here too.

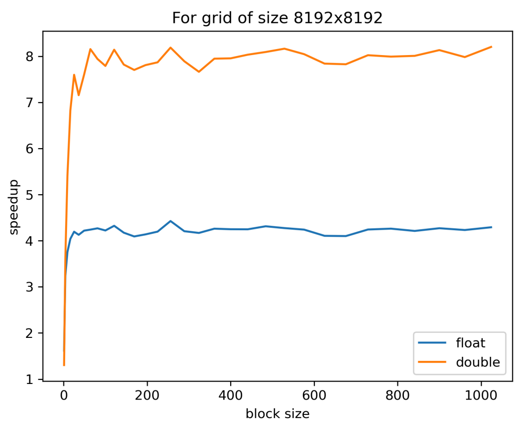
```
  printf("      -e           : will show the error between gpu and cpu vercions of
the code (default: no)
");
  printf("      -B   value   : will chage the block size for the cuda grid (default:
32)
");
  printf("      -r           : will print runtime properites into a .csv style file
(default: no)
");
```

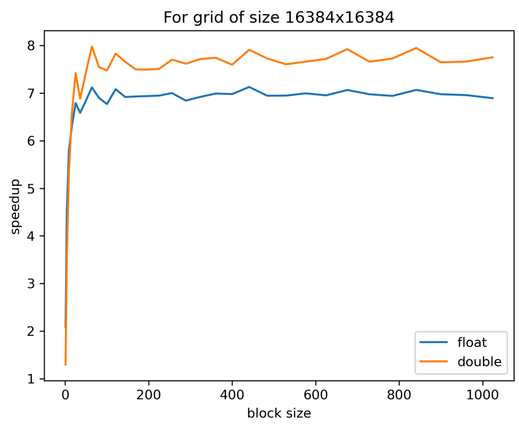
The following is output from "plotting.py".

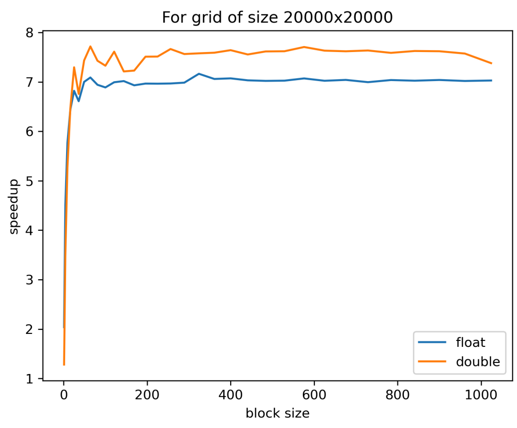
```
  The best block_size for floats for grid of 5000x5000: 196 = 14x14
  The best block_size for doubles for grid of 5000x5000: 64 = 8x8

  The best block_size for floats for grid of 8192x8192: 256 = 16x16
  The best block_size for doubles for grid of 8192x8192: 1024 = 32x32

  The best block_size for floats for grid of 16384x16384: 441 = 21x21
  The best block_size for doubles for grid of 16384x16384: 64 = 8x8

  The best block_size for floats for grid of 20000x20000: 324 = 18x18
  The best block_size for doubles for grid of 20000x20000: 64 = 8x8
```

And the performance against block size.









Task 2 - LLM Implementation

I used chat GPT and used the prompt "explain and make a cuda parallelised version of the following code" I then copy and pasted "main.cpp" Then got output of the following

https://chatgpt.com/share/682c696e-bc9c-8004-a268-d64d4be1cf29

I divided the generated code into how I understood the llm layed them out in the directory "LLMexponentialIntegral" along side the text output in "llm_output.txt".

For the most part the llm genenated correct results which look quite similar to my implementation. In their implementaion of the cuda kerel the only provide a version for floating point precision while I implemented a templated version which can proccess floats or double. It also used a 1 dimensional grid as oppesed to the 2d grid I used for indexing which I dont know if it makes a difference for this problem, other than having to think about the indexing a bit more in 1d.

In its "main.cpp" file uses a "cudaDeviceSynchronise()" function call right after the cuda kernel is called which is not neccesary since "cudaMemcpy(...)" is synchronous to the host, I found this int the cuda docs for this function

https://docs.nvidia.com/cuda/cuda-runtime-api/group__CUDART__MEMORY.html#group__CUDART__MEMORY_1gc263dbe6574220cc776b45438fc351e8

Otherwise the "main.cpp" function looks the same.

However without more probing of the LLM it only gives the following

```
nvcc -o expint_cuda main.cpp expint_gpu.cu -lcuda -lcudart
```

to complile the two files. With a quick try running the command doesnt work and produces a stream of errors.